

# Claims

- [c1] 1. A method of manufacturing a contact, comprising the steps of:  
providing a substrate having a first conductive layer and a dielectric layer thereon, wherein the dielectric layer has a contact opening that exposes a portion of the first conductive layer;  
forming a conductive nano-particle layer on the exposed surface of the first conductive layer; and  
forming a second conductive layer inside the contact opening to cover the conductive nano-particle layer.
- [c2] 2. The method of claim 1, wherein the conductive nano-particle layer comprises a metallic nano-particle layer.
- [c3] 3. The method of claim 1, wherein the conductive nano-particle layer comprises a silicon nano-particle layer.
- [c4] 4. The method of claim 1, wherein the nano-particles inside the conductive nano-particle layer has an average size smaller than 100 nanometers.
- [c5] 5. The method of claim 1, wherein after the step of forming the conductive nano-particle layer, furthermore comprises performing an annealing process.

- [c6] 6. The method of claim 5, wherein the annealing process is performed at a temperature between about 50°C to 300°C.
- [c7] 7. The method of claim 1, wherein the step of forming the nano-particle layer includes performing a charge adsorption process, comprising the steps of:  
immersing the substrate with the contact opening already formed thereon in a solution, wherein the solution contains dispersed conductive nano-particles; and  
passing a direct current into the solution so that the conductive nano-particles are adsorbed and adhered to the surface of the first conductive layer.
- [c8] 8. The method of claim 7, wherein the solution furthermore comprises some surfactant.
- [c9] 9. The method of claim 1, wherein the step of forming the nano-particle layer includes performing a charge deposition process, comprising the steps of:  
forming a patterned photoresist layer over the dielectric layer that exposes the contact opening;  
immersing the substrate structure into an electroplating solution, wherein the electroplating solution contains dispersed conductive nano-particles; and  
performing an electroplating process using the substrate

as an anode and a metallic electrode as a cathode to form the conductive nano-particle layer on the surface of the first conductive layer.

- [c10] 10. The method of claim 9, wherein the electroplating solution furthermore comprises some surfactant.
- [c11] 11. The method of claim 1, wherein the step of forming the nano-particle layer includes performing a molecular self-assembly process, comprising the steps of:  
immersing the substrate with a contact opening already formed thereon in a solution having self-assembly molecules so that the self-assembly molecules are adsorbed to the surface of the first conductive layer; and  
immersing the substrate in another solution, wherein the solution contains dispersed conductive nano-particles so that the nano-particles are adsorbed towards the layer of self-assembly molecules on the first conductive layer to form the conductive nano-particle layer.
- [c12] 12. The method of claim 11, wherein the solution furthermore comprises some surfactant.
- [c13] 13. A semiconductor device structure, comprising:  
a conductive layer formed on a substrate;  
a dielectric layer formed on the conductive layer;  
a contact formed in the dielectric layer, wherein the con-

tact and the conductive layer are electrically connected;  
and  
a conductive nano-particle layer formed between the  
conductive layer and the contact.

[c14] 14. The semiconductor device structure of claim 13,  
wherein the conductive nano-particle layer comprises a  
metallic nano-particle layer.

[c15] 15. The semiconductor device structure of claim 13,  
wherein the conductive nano-particle layer comprises a  
silicon nano-particle layer.

[c16] 16. The semiconductor device structure of claim 13,  
wherein conductive nano-particles in the conductive  
nano-particle layer have an average size smaller than  
100 nanometers.

[c17] 17. The semiconductor device structure of claim 13,  
wherein the conductive nano-particle layer comprises a  
nano-particle consolidated nano-particle film.

[c18] 18. The semiconductor device structure of claim 13,  
wherein material forming the conductive layer comprises  
aluminum.